

WHAT IS CLAIMED IS:

1. A motor driving device comprising:

a semiconductor switching element interposed in a current flowing passage to a motor;

5 a PWM control unit for generating a PWM signal having a predetermined PWM frequency;

a driving circuit for making the semiconductor switching element carry out a switching operation under plural driving states, and driving the semiconductor switching element in PWM  
10 (Pulse Width Modulation) mode according to the PWM signal under an instructed driving state;

an overheat state detecting unit for outputting an overheat state detecting signal on a condition that a temperature of the semiconductor switching element exceeds a predetermined  
15 threshold value and the semiconductor switching element falls into an overheat state or a state in which the probability that the semiconductor switching element will shift to the overheat state is higher than a predetermined probability; and

a driving control unit for instructing the driving state  
20 of the semiconductor switching element to the driving circuit so that the rise time and fall time of the semiconductor switching element during an output period of the overheat state detecting signal are shorter than the rise time and fall time of the semiconductor switching element during a non-output period of  
25 the overheat state detecting signal.

2. The motor driving device according to claim 1, wherein  
the driving control unit controls the PWM control unit so that  
the PWM frequency during the output period of the overheat state  
detecting signal is lower than the PWM frequency during the  
5 non-output period of the overheat state detecting signal.

3. The motor driving device according to claim 1, wherein  
the driving circuit varies a resistance value of a resistor  
connected to the semiconductor switching element on the basis  
10 of an instruction from the driving control unit to thereby vary  
the rise time and fall time of the semiconductor switching  
element.

4. The motor driving device according to claim 1, wherein  
15 the overheat state detecting unit includes a temperature  
detecting unit for detecting a temperature of the semiconductor  
switching element, and outputting the overheat state detecting  
signal during a period when the detected temperature exceeds  
the threshold value.

20

5. The motor driving device according to claim 1, wherein  
the overheat state detecting unit includes a current detecting  
unit for detecting current flowing in the semiconductor switching  
element, and outputting the overheat state detecting signal  
25 during a period when the detected current exceeds a predetermined  
threshold value.

6. The motor driving device according to claim 1, wherein the overheat state detecting unit includes a power supply voltage detecting unit for outputting the overheat state detecting signal during a period when a detected power supply voltage exceeds a predetermined threshold value.

7. The motor driving device according to claim 1, wherein the overheat state detecting unit outputs the overheat state detecting signal during a period when a duty ratio of PWM driving exceeds a predetermined threshold value.

8. The motor driving device according to claim 1, wherein the overheat state detecting unit outputs an overheat state detecting signal that has two threshold values for an output judgment of the overheat state detecting signal and is brought with a hysteresis characteristic.

9. The motor driving device according claim 1, wherein the PWM control unit is equipped with a motor voltage detecting unit for detecting a voltage applied to the motor, and determines the duty ratio of the PWM signal on the basis of an instructed motor voltage and a detected motor voltage.

10. The motor driving device according to claim 1, wherein the motor is an air blowing fan motor for a heat exchanger in a cooling system for a vehicle.

11. The motor driving device according to claim 2, wherein  
the PWM frequency during the output period of the overheat state  
detecting signal is set to an audible frequency band to thereby  
5 provide human perception.

12. The motor driving device according to claim 2, wherein  
the driving circuit varies a resistance value of a resistor  
connected to the semiconductor switching element on the basis  
10 of an instruction from the driving control unit to thereby vary  
the rise time and fall time of the semiconductor switching  
element.

13. The motor driving device according to claim 12, wherein  
15 the overheat state detecting unit includes a temperature  
detecting unit for detecting a temperature of the semiconductor  
switching element, and outputting the overheat state detecting  
signal during a period when the detected temperature exceeds  
the threshold value.

20

14. The motor driving device according to claim 12, wherein  
the overheat state detecting unit includes a current detecting  
unit for detecting current flowing in the semiconductor switching  
element, and outputting the overheat state detecting signal  
25 during a period when the detected current exceeds a predetermined  
threshold value.

15. The motor driving device according to claim 12, wherein  
the overheat state detecting unit includes a power supply voltage  
detecting unit for outputting the overheat state detecting signal  
during a period when a detected power supply voltage exceeds  
5 a predetermined threshold value.

16. The motor driving device according to claim 12, wherein  
the overheat state detecting unit outputs the overheat state  
detecting signal during a period when a duty ratio of PWM driving  
10 exceeds a predetermined threshold value.

17. The motor driving device according to claim 12, wherein  
the PWM control unit is equipped with a motor voltage detecting  
unit for detecting a voltage applied to the motor, and determines  
15 the duty ratio of the PWM signal on the basis of an instructed  
motor voltage and a detected motor voltage.